TERRA

THE NATURAL HISTORY MUSEUM OF LOS ANGELES COUNTY
VOL. 25, NO. 6 · JULY/AUGUST 1987

Silver in the Golden State

see page 4

Sylinda Deacon (third grade, La Cañada Elementary) drew this bemused Imperial Mammoth for the Page Museum's Story and Picture Contest, held in celebration of the Page Museum's tenth birthday.

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TERRA

THE MEMBERS' MAGAZINE
OF THE NATURAL HISTORY MUSEUM
OF LOS ANGELES COUNTY
AND THE PAGE MUSEUM
OF LA BREA DISCOVERIES

VOL. 25, NO. 6 · JULY/AUGUST 1987

COVER: A mirror-smooth finish distinguishes this reinterpretation by California silversmith Arthur Thumler of an early American Liverpool jug. The Natural History Museum presents Silver in the Golden State, an exhibition organized by the Oakland Museum (Olympics Gallery, August 15 through November 2, 1987). Photograph by Stephen Rahn.

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SILVER IN THE GOLDEN STATE
California's Silver Lining

by DEBORAH COOPER

"Mining on the Comstock" shows a large-scale operation that employed hundreds of men in a vast network of underground tunnels. The square-set timbering used to keep the tunnels from collapsing was just one of the technological innovations that made the Comstock possible. Lent by The Bancroft Library; photograph by Stephen Rahn.

California is a silver-gilt state. She is called the "Golden State," an image that flowed out of Sierra Nevada streams full of gold nuggets. The image was spread, first by the Gold Rush 49ers and later by real estate developers who promoted California as the land of healthful golden sunshine set amid fields of golden poppies reached through a Golden Gate. But California is twice blessed. Beneath this shiny golden exterior is an equally rich foundation of silver. Silver in the Golden State, a traveling exhibition organized by the Oakland Museum, reveals the golden state's silver lining.

Silver Lodes and Silver Kings. The largest of the United States' great silver bonanzas occurred in what is now Nevada. Just as the gold began to play out on the western slope of the Sierra Nevada Mountains, tremendous deposits of silver were discovered on the eastern side. The Comstock Lode, from which the great Nevada silver mines drew their ore, was the new big bonanza. It produced close to $200 million in silver—at nineteenth-century prices—from its discovery in 1859 to its decline in the early 1880s.

Virginia City, Nevada, the site of the silver mines, boomed. Mansions, hotels, theaters, schools, and churches sprung

Silverminers underground at the Chollar Mine worked with huge pneumatic drills. Courtesy of Chris Kiechler, owner of the Chollar Mine.

forth as part of a bustling community that boasted volunteer fire departments, fraternal organizations, and Sunday school picnics. Elegance prevailed in many quarters: restaurants offered oysters on the half shell, roast turkey, ribs of beef, stewed terrapin, fresh vegetables, and sumptuous desserts to patrons on their way to performances at Piper's Opera House.

In other quarters, of course, life was less plush. Ethnic and racial minorities found themselves with few opportunities for work and little choice in housing. The miners, who were primarily American, Canadian, British, or German, were better off. They had developed local labor unions in the early 1860s and were successful in their demand for a $4 a day wage for eight-hour shifts. This was at least double the pay miners elsewhere received, and a commentator at the time described them as "well fed, well clothed, and well lodged." Although they enjoyed all the amenities Virginia City had to offer above ground and rubbed shoulders with the wealthy nabobs at restaurants and theaters, their lives underground were full of danger. Temperatures in excess of 100 degrees, foul air, pools of scalding water, horrifying accidents in mine shafts 1000 feet deep, and

California silversmith Clemens Friedell was a master with a chasing hammer. The silver plate was held in a bowl of warm, soft pitch, which supported it while Friedell used a hammer and punches to raise the decoration. Courtesy of Richard Friedell.

raging fires that trapped and suffocated miners were among the hazards the men had to face each day. For all this, their good wages were but a small percentage of the wealth produced by the mines.

But what did this bonanza of Nevada silver mean for California? Where did all that wealth go? The big money from the mines did not stay in Virginia City; it found its way to San Francisco instead. If the Gold Rush made a boom town of San Francisco, the silver rush transformed it into a city. Added to the flow of silver itself into San Francisco was the great bonanza in mining stocks, and that took place on the San Francisco Stock Exchange.

"It takes gold to run a silver mine," goes an old Spanish proverb. That was especially true on the Comstock. Initially, miners were able to extract the silver ore using hand tools and relatively small-scale machinery. But their search for ore led them deeper and deeper underground into difficult geological formations. It soon became apparent that new technology and large-scale machinery would be required to timber, drain, and ventilate the mine shafts as well as to drill, blast, and hoist out the ore. All this required a substantial investment of capital—and herein lies a vital link to California.

The bankers resided in California. Most prominent among them were William Ralston, D.O. Mills, and William Sharon, who came to be known as the "Bank Crowd." Founders of the Bank of California, they lent money at low interest rates to mining companies. When times were slim and loan payments fell behind, they foreclosed and bought up the properties. By the late 1860s, the "Crowd" controlled all the major mines on the Comstock. The money poured into their pockets and into San Francisco as well. The Palace Hotel, built by William Ralston, stands as a monument to their influence on the development of San Francisco. The most elegant hotel of its day, it suited a city awash in silver. One sumptuous dinner at the Palace Hotel boasted individual menus engraved on silver plaques to be taken home as souvenirs of the occasion.

Bankers were not the only source of funds. Many of the mines began offering shares of stock for public sale to raise the needed capital for operations. The public responded with an enthusiasm that bordered on mania. Investing in mining stocks became an international craze. Its focus was the San Francisco Stock Exchange, established in 1862 specifically to trade in Comstock shares. It was a rollercoaster market in which fortunes were made and lost on a daily basis. Speculators soon realized that the trading floor was a rich lode regardless of how the mines themselves were doing. Stock prices were governed by rumor and manipulation as much as anything, and savvy investors took full advantage of the opportunity to make a quick buck. Money made in the stock exchange established San Francisco as the major financial center on the West Coast.

Speculating in stocks was one way to make money. Buying enough stock was one way to gain control of a mine, and for the lucky few, this was the road to fabulous wealth. The "Bonanza Kings" are the best known of the speculators who turned stock certificates into silver ore. John Mackay, James Fair, James Flood, and William O'Brien formed the Bonanza Firm in 1869 and gained control of the Hale and Norcross Mine. It was one of the richest on the Comstock, but even it could not compare with their 1871 acquisition of the Consolidated Virginia Mine. In 1873, the Con. Virginia struck the biggest bonanza in Comstock history, eventually producing over $64 million in precious metal. Again the money flowed into California, building office blocks, theaters, and mansions as well as personal fortunes.

San Francisco flourished as a result of these nouveaux riches. Its port facilities, its manufacturers and suppliers, and its financial institutions all expanded under the influence of Comstock silver. But it was not the only California city to get a boost from silver. Los Angeles had its own "Comstock." Less well known and certainly smaller, the Cerro Gordo mines nevertheless contributed importantly to the development of the City of the Angeles in the 1870s.

Cerro Gordo, which translates as "fat mountain," lay near what was Owens Lake in Inyo County. Mexican miners were the first to discover the rich silver-lead ore and the first to mine the region. As news of their strikes leaked to the outside world, a small silver rush brought an influx of hopeful miners. Among the newcomers were Victor Beaudry and Mortimer Belshaw, who employed the tactics of the Bank Crowd to gain control of both the mines and the processing mills at Cerro Gordo. The personal fortunes to be made were theirs—almost.

First, they had a problem to solve. The ore at Cerro Gordo was rich in both silver and lead, but the smelters able to separate the two were far away in San Francisco. Thousands of silver-lead ingots, weighing eighty-five pounds apiece, were worthless unless they could be gotten out of this remote corner of California. It was Remi Nadeau who came up with the solution. He hitched wagons to twenty-mule teams and, starting from Los Angeles, made the 275-mile trip across the desert, hauling supplies into Cerro Gordo and hauling ingots out. By establishing stations along the route, he was able to keep a continuous relay of dozens of mule teams and wagons constantly moving. No small undertaking, but since he held a virtual monopoly on transportation to and from Cerro Gordo, it was quite profitable.

It was profitable also for business in Los Angeles. Merchants provided supplies for Cerro Gordo; blacksmiths and wagon builders serviced Nadeau's teams; foundries and machine shops filled orders for mining equipment; business at the port boomed as the ingots were shipped to Selby Smelting and Lead Co. in San Francisco. Indeed, Cerro Gordo silver stimulated the transformation of a small town into California's largest city.

Silver Bars and Silver Service. While the Golden State's two major cities owe much to the silver lodes, there is more to the story of silver in California—the art of her silversmiths. Once the silver was recovered from the ground, California's silversmiths turned it into objects of beauty: silver to commemorate special events, silver for the dining table, silver as a conspicuous status symbol—all were within the repertoire of California's silversmiths.

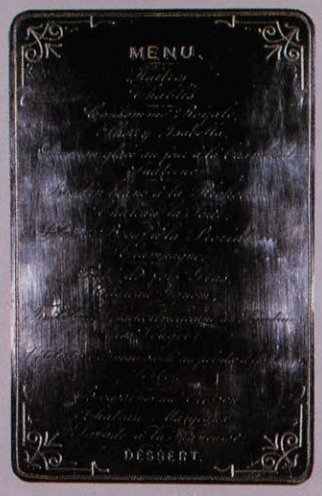
As the money from the mines poured into San Francisco, it created an ideal market for silverware. A wealthy clientele demanded luxury goods appropriate to their social standing. Among the first to take advantage of this burgeoning

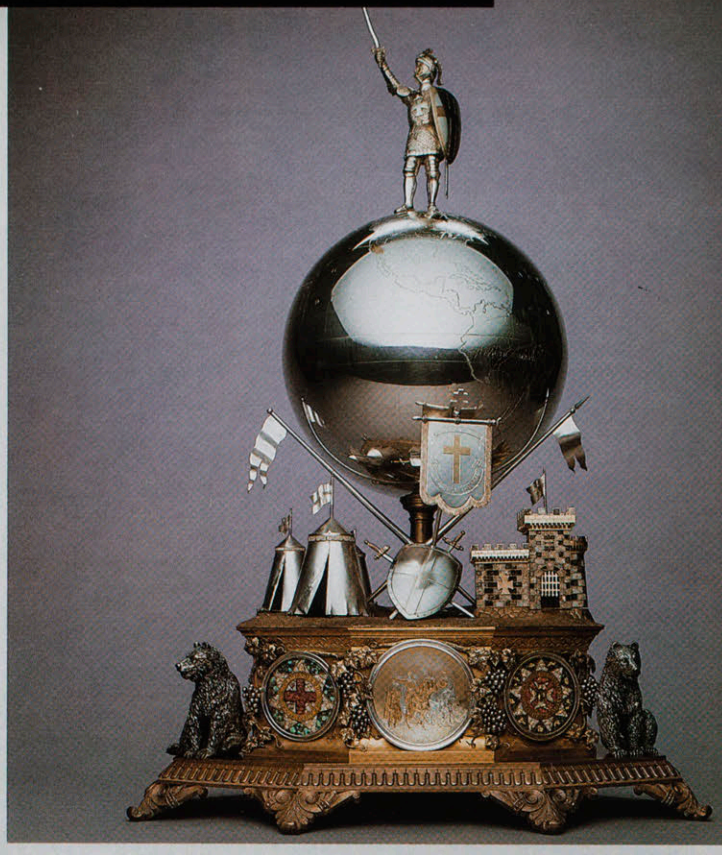
market was George C. Shreve, who arrived in San Francisco with his brother in 1852. They established a retail jewelry shop and stocked it with silver brought "'round the horn" from the East Coast. Before the end of the decade, Frederick Reichel and William K. Vanderslice were both producing silver goods in San Francisco. And by the late 1860s, Schulz & Fischer and Koelher & Ritter had opened shops to sell their own wares as well as imported pieces. Shreve began producing silverwares in 1883 and, with the other four, can be credited as the source of most silver made in California before the end of the century.

In the mid-nineteenth century, the production of silver was transformed by the introduction of mass-production techniques and steam power. San Francisco's silversmiths joined the industrial revolution, establishing factories to fill special orders as well as mass produce retail goods. They employed numerous workmen who operated steam-powered lathes, cutters, and flatting and rolling mills. With this equipment they were able to shape sheets of silver quickly by spinning them into hollow forms on a lathe. Even the most complex pieces could be spun in sections and then soldered together. Large presses fitted with steel dies were used to stamp out decorative bands of silver, which could then be applied over soldered seams and around edges. Dies were also used to stamp out knives, forks, and spoons in a variety of patented patterns. Designs for the silver, even those that were patented, were usually copied with minor variations from the work of East Coast silversmiths. Popular taste and prevailing fashions dictated what the successful silversmith *cum* businessman would produce.

William Sharon was honored by a dinner at the Palace Hotel. The luxury made possible by Comstock riches is evident in the menu, not only in the food served, but also in the silver plaques on which it is engraved. Lent by the California State Society, DAR; photograph by John Blaisdell.

Shreve made a fitting California trophy for the Knights Templar conclave in San Francisco. The golden state is inlaid on a silver globe. Lent by the Saint Bernard Commandery of the Knights Templar, Chicago; photograph by Stephen Rahn.





Victorian style was ornamental in the extreme. This monumental centerpiece by Vanderslice combines beading, swags, goats' heads, and, in celebration of the machine age, gear wheels. Lent by the Society of California Pioneers; photograph by Stephen Rahn.

The Arts and Crafts movement inspired Porter Blanchard's work. His love of form rather than ornament is evident in the clean lines of this tea set. Lent by D.J. Puffert; photograph by Stephen Rahn.

By the turn of the century, all these firms except Shreve, the largest, had gone out of business. The production of silver in California took a new turn under the influence of the Arts and Crafts movement. Shreve began making what is called the "14th Century" pattern in flatware and holloware. It was their own creation rather than a copy of East Coast work, and it aimed for the high-quality, hand-crafted appearance demanded by the new style. Hammered surfaces suggested the work of the hand craftsman, and differently shaped handles within flatware sets suggested individual creativity rather than machine mass-production.

Although Shreve achieved the arts and crafts look in a factory setting, several new silversmiths working in California followed the tenets of the Arts and Crafts movement more closely. Most prominent among these were Porter Blanchard and Clemens Friedell in southern California, and Arthur Thumler in San Francisco. Although they did employ both men and machinery in producing some of their work, much work was done by hand by the firms' principals. Clemens Friedell, for example, would often spend fourteen hours a day hand-chasing the decoration on pieces of silver. Arthur Thumler would hand raise, rather than spin holloware from flat sheets of silver, achieving a mirror-smooth finish that was a testament to his skill. The designs for the silver were the creative work of an individual, rather than copies following popular taste. Porter Blanchard, for example, often worked in the Colonial Revival style, but his was a unique twentieth-century interpretation. When compared to the work of Thumler, who also worked in the Colonial Revival style, the differences in their artistic visions are readily apparent.

All these silversmiths, with the exception of Thumler, were immigrants to California from eastern states and from Europe. They came here to seek their fortunes, to take advantage of the silver lining in the Golden State. As Blanchard wrote of his reasons for coming:

> [We're] one of the first million in Southern California.... We're here sure enough, and "no foolin'" in the much advertised and criticized (advertised East—criticized West) land of sunshine and sandstorms (last not advertised). That's why we're here (and the other 999,999 also I believe) to see if what you talked about, your wonderful California, was in fact or fiction.

Mostly they found it a fact, and hence we have been left with a legacy of silver made in California.

Silver Symbols. Silver is not only a source of wealth; it is also a symbol of wealth. Displayed on the dining room table, it proclaims its owner's social standing and ability to pay. When John Mackay determined to set a table appropriate to his status as a Bonanza King, he had silver from his own mine sent to Tiffany and Co. in New York. Two hundred workmen spent a year creating over a thousand pieces for the dinner service. The *New York Daily Tribune* reported in 1878:

> The service is a monument to the wealth of the owner...to impress the beholder at the same time with the enormous costliness of the service and the skill of its makers—is apparently the object...of this large accumulation of coin and cunning.

Few were able to furnish their tables this elaborately but many sought to include at least some silver to add upscale sparkle to tea or dinner-time rituals. In the late nineteenth century, the dinner table became a theater of sorts for acting out complex social roles prescribed by an intricate code of etiquette. Knowing the proper use of silverware was not the least of the players' accomplishments. A *faux pas* in the use of a fork might betray one as ill-bred and unworthy of a part in the play.

Technology itself contributed to the trend toward social complexity. New canning processes and refrigerated railroad cars made new foods available to urban dwellers. Victorian ingenuity responded with the invention of many new, specialized dining utensils. These were often fashioned out of silver. As train cars brought fresh oranges to the cities, silver orange holders and orange knives and spoons were developed so diners could enjoy this luxury without having to commit the terrible sin of touching their food at the dinner table. When the newly invented tin can made sardines a year-round taste treat, sardine holders appeared to gracefully disguise the can as the sardines were served. Other foods demanded equally specialized silver serving utensils—asparagus tongs, mango forks, lettuce forks, and tomato servers were but a few of the new utensils available. Even Saratoga chips (potato chips to you and me) had a special serving utensil.

Silver had other roles to play as well. As a precious metal, its presence lent importance to many occasions. A silver spike accompanied the golden spike at the joining of the last rails of the transcontinental railroad at Promontory, Utah, in 1869. Its inscription reflects the importance of the occasion: "To the iron of the east and the gold of the west, Nevada adds her link of silver to span the continent, and wed the Oceans." The Knights Templar chose a silver globe with California inlaid in gold to honor excellence in competitive marching at their 1883 conclave in San Francisco. The Pacific States Telephone and Telegraph Company presented a silver punch bowl to its departing president. A silver trowel was used to lay the cornerstone of the Los Angeles County Courthouse in 1880. And sports lovers, be they yachtsmen, rodeo riders, or Peanut League champs, have seen their victories reflected in the gleam of silver trophies.

On the home front, the child raised with a silver spoon in his or her mouth is considered fortunate indeed. Silver baby cups are not uncommon. Brides register their silver patterns in hopes of being able to set an elegant table. Silver is judged a fitting reward for twenty-five years of marriage. And silver is often a family treasure that is handed down from one generation to the next, helping to preserve our links to the past.

In the twentieth century, new silver symbols have appeared. These symbols are often not made of silver, but simply make use of silver's glamour. Songsters crooned of a "Silv'ry Moon" or of "Silver Threads Among the Gold." The silver screen gave us the *Silver Streak*, the *Silver Queen*, and the *Silver Lode*, to mention just a few. The Lone Ranger—quintessential symbol of the romantic West—fired silver bullets from astride a horse named Silver. Given all this silver, in fact and in fiction, the Golden State must recognize that "all that glitters is not gold."

Deborah Cooper, author of this article, is registrar at The Oakland Museum and exhibit coordinator for Silver in the Golden State.

Silver in the Golden State will be on exhibit at the Los Angeles County Museum of Natural History from August 15 through November 2, 1987.

A male Eastern timber wolf in his enclosure at Wolf Haven near Tenino, Washington. Efforts to reintroduce this and the other remaining races of gray wolf back into their native regions can succeed only if we can overcome our historic prejudices against this magnificent Ice Age carnivore.

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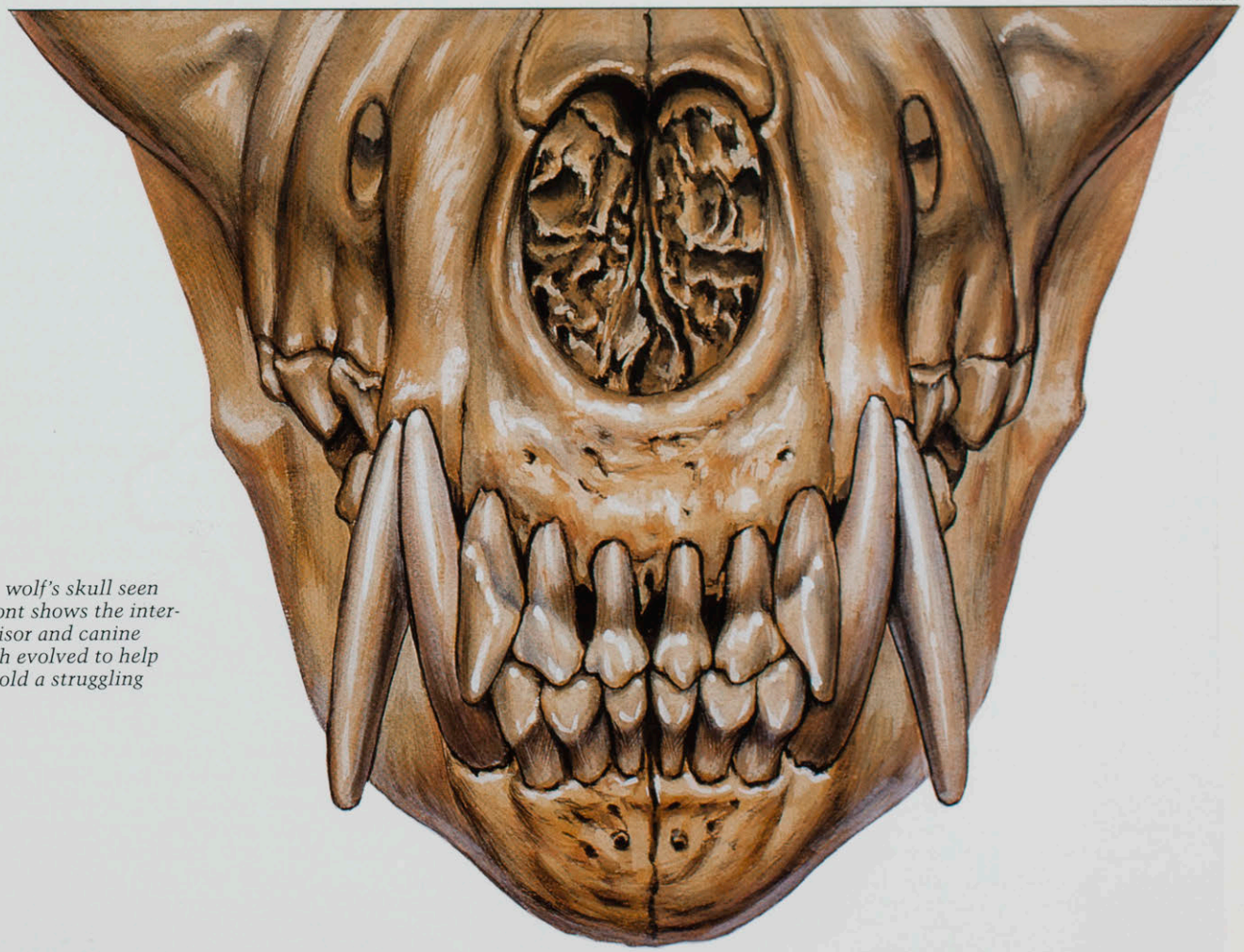
TWO WOLVES, ONE LAND
Could Two Closely Related Social Predators Share the Same Environment?

© 1986 Mark Hallett



A view of a wolf's skull seen from the front shows the interlocking incisor and canine teeth, which evolved to help seize and hold a struggling animal.

by MARK HALLETT
Illustrations by Mark Hallett, photograph by Veronica Tagland

In 1977 a long-held dream of businessman and philanthropist George C. Page was realized—a museum devoted to the Ice Age fossils found at Rancho La Brea was opened at the tar pits' site in Hancock Park. This satellite facility of the Natural History Museum has been delighting the seven million visitors from Los Angeles and the world alike that have explored the museum over the past ten years. "Two Wolves, One Land," an article discussing the dire wolf, a now extinct-member of the dog family that is the animal most commonly found in the Rancho La Brea deposits (the bones of more than 1,600 individuals have been recovered), is offered by TERRA in honor of the George C. Page Museum of La Brea Discoveries' tenth birthday. Many, many happy returns!

Wolves, until man so devastatingly reduced their numbers in historic times, were among the most widely dispersed and adaptable of large North American carnivores. The modern gray wolf *(Canis lupus)* until recently ranged over nearly all of present-day Canada, the United States, and northern Mexico, sharing its habitat with the closely related red wolf *(C. rufus)*, and the coyote *(C. latrans)*.

North America during the Wisconsin Glacial Period about 18,000 years ago, showing places where dire and gray wolf fossils have been found. Recovered mostly from cave fissure deposits or natural traps, the fossils suggest that while both species ranged over most of the lower 48 states, only gray wolves occupied Canada and Beringia; dire wolves, on the other hand, ranged as far south as Peru.

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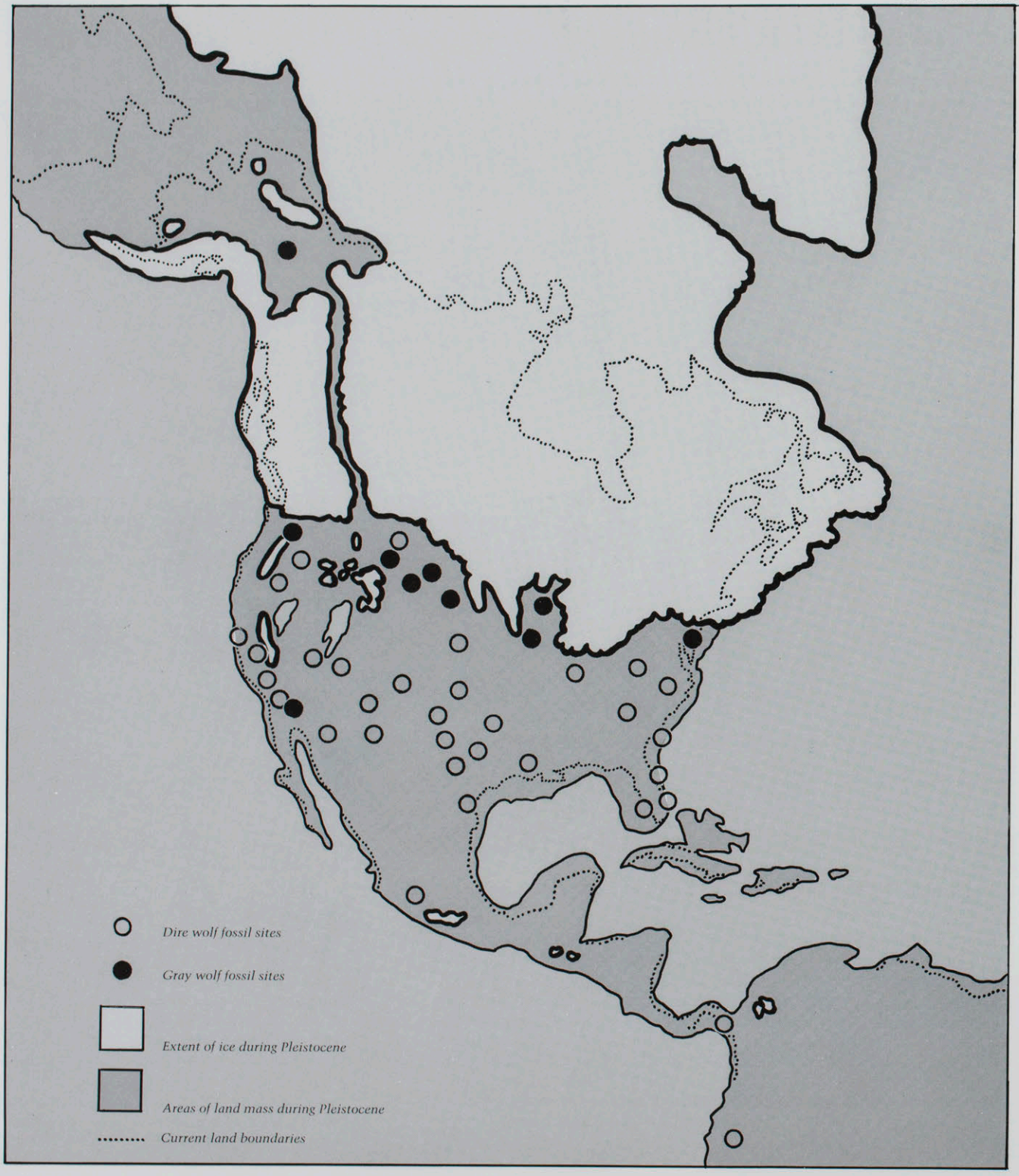
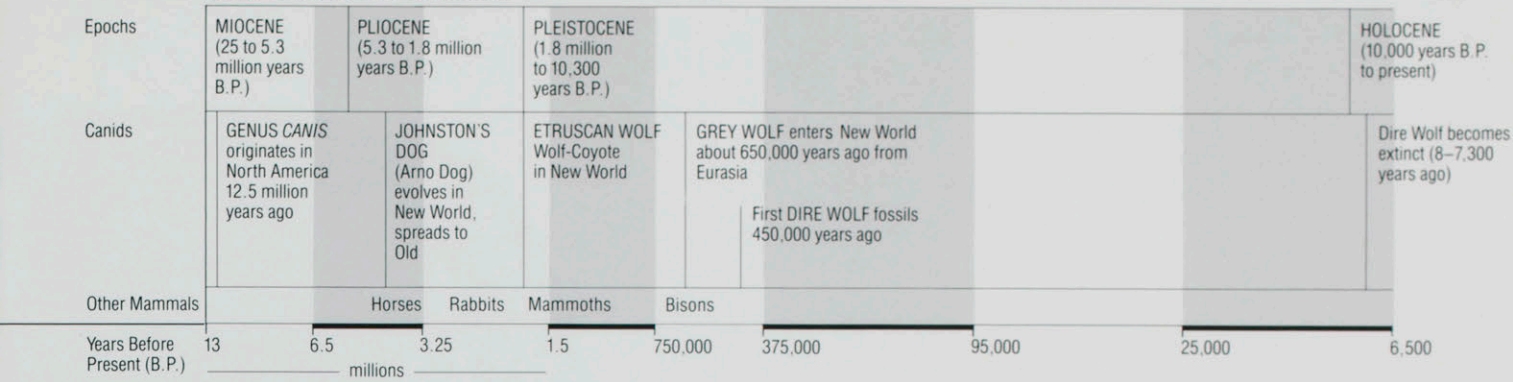

Dire wolf fossil sites
Gray wolf fossil sites
Extent of ice during Pleistocene
Areas of land mass during Pleistocene
Current land boundaries

TIME LINE FOR CANIDS



During the Pleistocene period or "Ice Age" (around 10,000 to 2 million years ago), however, another large canid also occurred in North America. Fossil remains of the now-extinct dire or grim wolf *(C. dirus)* have been found from Peru to Alberta, Canada. Remains of gray wolves seem to be rare in the Pleistocene fossil record, while dire wolves are apparently the common, prevalent wolf species. Was the extinct wolf actually a superior competitor to its living cousin in the role of North America's largest canine predator?

The answer begins with a look at what is known of wolf evolution. Wolves, coyotes, and jackals are all members of the genus *Canis*, a group separate from foxes, African hunting dogs, dholes, and other doglike carnivores. Originating far back in the ancient grassland epoch of the North American Miocene about 12.5 million years ago, the canids started as small-time carnivores in a scene dominated by the big, highly successful *amphicyonids* or "bear dogs," which filled the role of true bears, wolves, and hyenas on the North American plains.

By the end of the Pliocene Epoch, some 7 million years later, however, the evolutionary scene was changing. Climates were growing cooler, ancient ecosystems were breaking down, and many long-successful mammals were dying out. The amphicyonids declined, and the woods and plains were now patrolled by bigger and smarter canids whose fossil braincasts suggest the increased capacity for social and cooperative hunting behavior that characterizes today's modern species. One of these bigger and smarter canids was Johnston's dog *(C. lepophagus)*, a coyotelike canid that probably originated in North America and by early Pleistocene times had spread to Eurasia, where it is known to European paleontologists as the Arno dog.

During the Pleistocene Epoch's glacial periods, lowered sea levels from time to time united Eurasia and North America through the Siberian-Alaskan land bridge called *Beringia* into a vast land area called *Holarctica* (see map on page 12). Because of the Beringia connection, many families of Pleistocene mammals evolved and became dispersed on both continents, including several types of ancient canids. Johnston's dog and the Arno dog thus became populations or races of a single holarctic species. Features of the skull and teeth of Johnston's dog suggest that it was probably the direct ancestor of the modern coyote, while those of the Arno dog show similarities to the coyote's ecological equivalent in the Old World, the jackal *(C. aureus* and others). The now highly endangered red wolf *(C. rufus)*, of the southeastern United States, probably arose from this early coyote, and further finds and studies may reveal Johnston's dog to be the ancestor of all Pleistocene canids in the New World.

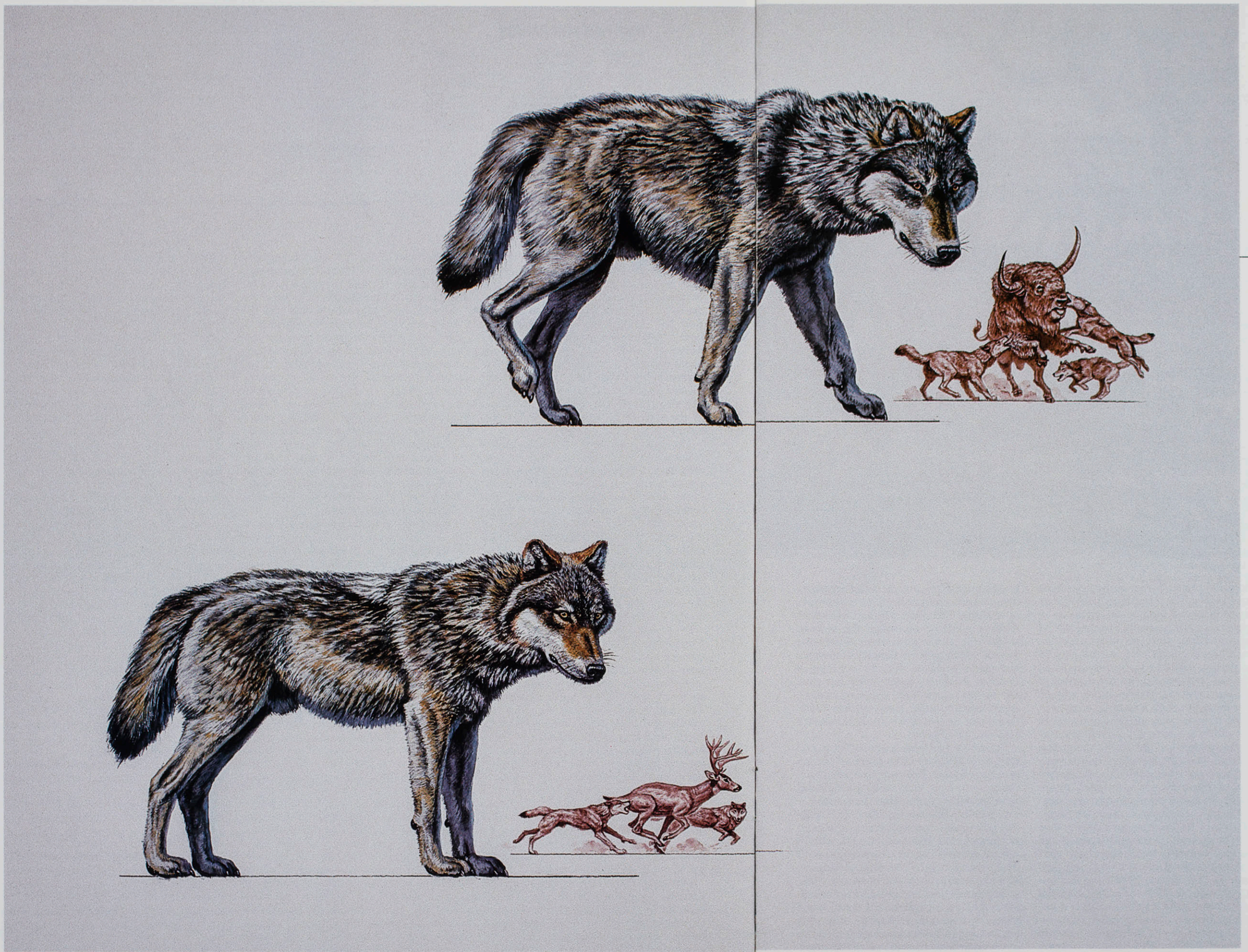
If coyotes actually pre-date wolves in their evolution instead of being a sort of little brother, where did the larger relative come from, and when? The answer lies in the northernmost lands of Holarctica. Here Johnston's/Arno dog populations were evolving into the first true wolf. *C. etruscus*, known as the Etruscan wolf in Europe and as the wolf-coyote in the New World. Larger size, a broader muzzle, and more powerful jaw muscles distinguish wolves from coyotes, all of which equip wolves for killing larger prey. In the natural world a vacant ecological niche represents an evolutionary opportunity, and the wolf-coyotes were exploiting the role of medium-size social predator once occupied by the ancient amphicyonids. Instead of rabbits and other small prey, they were tackling bigger game such as deer and antelope, and their group hunting skills became sharpened to cope with the challenge of outwitting and outmaneuvering these animals.

Fossil sites in France and other European localities indicate these early wolves preferred woodland to plains habitats, but as the relatively milder climate of the earliest Pleistocene gave way to a succession of glacial and interglacial periods, migratory prey such as caribou and musk ox that favored the barren steppes evolved. Wolves evolved longer limbs and tireless running and trotting abilities to follow these wide-ranging ungulates, and when the search for new grazing grounds brought such hoofed game into Beringia, the modern gray or timber wolf *C. lupus* was following them. The first fossil remains of gray wolf in North America are found at Hay Springs in Nebraska, a late Irvingtonian Stage (middle Pleistocene) site about 650,000 years old, but the actual entrance of *C. lupus* into the New World from Eurasia probably took place earlier, about 700,000 to 750,000 years ago.

The origins of the dire wolf are less certain. Although the earliest occurrence of *C. dirus* comes from roughly the same geographic area as the gray wolf, its bones are about 200,000 years younger. *C. dirus* was the most common type of wolf in North America until 7,500 or 8,000 years before the present, when it became extinct and was replaced by the gray wolf. What is known is that while *C. lupus* was evolving from the Etruscan form during the first glacial period, another early wolf had already made its appearance in America and Eurasia. Known as Falconer's or Armbruster's wolf *(C. falconeri)*, its proportions and skeletal features seem to fit the ancestry of the dire wolf. Some paleontologists, however, claim that an extinct South American wolflike canid, *C. nehringi*, shows important points of similarity.

Slightly larger and taller than the gray wolf, the dire wolf was sturdier and considerably heavier, surpassing in weight the biggest of today's large tundra wolves by about 20 percent. With stronger shoulders, a deeper chest, and a massive pelvis, the dire wolf also had shorter feet than the gray wolf, while its skull was wider and more robust, the skull crest more backwardly projecting, and the carnassial teeth (used for cutting rather than tearing) especially large and powerful.

These carnassials and the modifications to the skull for more powerful jaw muscles are characteristic of carnivores such as hyenas that crush bones as they eat. This is carried to an extreme in the noncanine hyenas and an extinct family



The stocky and powerful body of the extinct dire wolf (top) differed from that of the gray wolf, which still roams parts of North America. The dire wolf had a deeper, broader skull, more massive size and shape, robust chest and hips, and smaller feet. These were probably adaptations to overcoming large prey, while the gray wolf's rangier build became suited to capturing more medium-size prey. Color shown for the dire wolf is conjectural; individual gray wolves may vary from almost white to jet black.

of canids, the borophagine dogs. Although the dire wolf displays a more moderate development, its tooth and skull development suggest that these wolves tended to scavenge.

Scavengers, however, rarely make a living only by eating carrion, and like hyenas, dire wolves were almost certainly active hunters of large prey. Although the dire wolf's heavy build and shorter feet probably denied it the speed and long-range running and trotting abilities of the gray wolf, they might have given it greater strength and maneuverability in tackling larger and more powerful prey. While today's gray wolves can dispatch ungulates as formidable as bison and moose, during the Pleistocene their role may have been mainly as predators of medium-size ungulates such as deer, antelope, and big-horn sheep, while dire wolves were more effective in killing such animals as giant bison, moose, and camel. Judging from the powerful bite of the living species, the massive jaws of the dire wolf must have been capable of tremendous strength in crippling and restraining a struggling animal. Several subspecies of the dire wolf are generally recognized, each showing differences in skull proportions, tooth size and shape, and limb length that perhaps reflect adaptations for killing different types of large prey; this parallels the racial variation seen in today's lobo, in which subspecies such as the now almost-extinct buffalo or plains wolf *(C. lupus nubilis)*, have heavier, deeper muzzles than other races for attacking bison.

Although the Pleistocene ranges of both the dire and gray wolves appear to have been similar across what are now the lower 48 states, the dire wolf is strangely absent from southern Alberta northward through Beringia, while grays are missing from the dire wolf's southern range extending to Peru. The reason for this is at present a mystery, but a possible answer may lie in the filtering effect the northern and southern climatic zones may have had on each wolf's type of

preferred prey.

Ecologically, gray and dire wolves may have co-existed in Pleistocene North America the way the cape hunting dog *(Lycaeon pictus)* and the spotted hyena *(Crocuta crocuta)* do today in southern and east Africa. While both carnivores often prey on the same ungulates such as wildebeest and zebra, differing habits tend to minimize the possibility of competition: hunting dogs are mostly active during the day, a time when hyenas mainly occupy the role of scavengers, but at night when the former reduce their hunting activities, hyenas become bold and deadly predators, slipping into the role that the dogs occupied earlier in the day. There is no way of knowing whether dire and gray wolves also worked similar shifts, but it is highly likely that probable differences in prey preference as well as hunting and scavenging proclivities made conflict between the two wolf species unlikely. Although not nearly as specialized as the hyena for crushing bones, dire wolves probably filled the role of social scavenger-predator in late Pleistocene North and South America that the spotted hyena does today in Africa, while the tireless long-distance pursuit of prey by the gray wolf is very similar to that of the hunting dog.

If dire and gray wolves occupied differing but complementary roles as major predators, why then was the former so abundant and the latter so rare? Does the predominance of dire wolves in the fossil record mean that it was the more successful of the two canids during the Pleistocene?

Although dire wolves are usually found instead of grays at many Ice Age sites, this could have reflected a bias in preservation due to behavior: if *C. dirus* was more of a scavenger, the huge numbers of individuals found at natural traps such as Rancho La Brea may have resulted from the greater tendency for a social scavenger to be preserved at such sites, both because they would be more likely to be attracted by carrion, and their group behavior would mean more animals would risk entrapment. Gray wolves, which were less dependent on carrion as a source of food, may have visited such sites less frequently and thus be underrepresented as fossils. Another factor that may have affected the greater incidence of dire wolf over gray wolf preservation could have been the average number of individuals in each species' typical hunting pack.

A sketch for a mural of Rancholabrean (latest Pleistocene) mammals painted by Charles R. Knight in 1927 suggests the partial role played by the dire wolf, seen to the left. Possibly relying occasionally on kills made by larger predators such as the saber-toothed cat Smilodon, *center, they were probably also active hunters and killed large prey such as the camel.*

Adolph Murie and other authorities have found that while most North American gray wolf packs tend to be made up of from six to ten actively hunting adults and juveniles, they can sometimes be much larger, comprising as many as 25 and on one rare occasion as many as 50 individuals, depending on the number of families involved. There is no way of estimating the pack size of *C. dirus*, but if the comparison of dire wolves to spotted hyenas as social scavengers may also be extended to the size of the group, packs of from 25 to 60 members may have been possible; under these circumstances there would also be a much greater chance of entrapment or incidental death than for that of a smaller group.

There is finally the possibility that there is no bias in the incidence of the two species in the fossil record and that gray wolves were *always* relatively less common than dire wolves until the latter's extinction. This may have nothing to do with one predator being more dominant or being a more effective competitor, but may possibly hinge on subtle factors of ecology that may be forever unknowable to us. African hunting dogs, which enjoy a higher success rate in making kills than almost any other African predator including the spotted hyena, are much rarer than the hyena due to outbreaks of canine distemper and other diseases that do not appear to affect the latter as seriously, but they are nevertheless highly evolved carnivores whose social behavior has made them just as much of an evolutionary success as the hyena.

Rounding out the scene of dire and gray wolf coexistence in North America was the coyote. The range of late Pleistocene coyotes was until postglacial time actually greater than it is today, a fact possibly due to the differing ecological role of the dire wolf versus the gray: whereas today the behavior of wolves toward coyotes is generally hostile, with the former generally treating the latter as a rival predator, dire wolves in their role as big game hunters and major scavengers probably considered the small canid more as a nuisance than as a serious competitor, to be chased away from a kill when they tried to steal scraps of meat. Coyotes for their part may have depended considerably on dire wolf kills to supplement their diet of rodents and other small prey.

This situation was not to last for much longer. With the waning of the last glacial period, known as the Wisconsin period (16,500 to 8,000 years ago), a wave of large mammal extinctions swept over North America and the rest of the globe. Many of the Earth's largest, most spectacular, and seemingly most well-adapted species died out, and among them was the dire wolf. Why did this widespread and successful carnivore disappear?

Contrary to what is often thought, "Ice Age" animals were not just arctic types such as mammoths, wandering in a bleak and frigid landscape. During the Pleistocene's glacial periods, the weather in North America was cooler but more stable than it is today and there were many subarctic and temperate environments no longer found in North America. These ancient plant communities, at present dispersed and widely separated in response to current extremes of cold, heat, and rainfall, were then probably capable of supporting a much greater variety and abundance of medium-size and large herbivores than they do now. Spared the blistering summers and bitter winters that currently characterize the interior of the continent, extinct species, including mammoth, mastodon, sloth, horse, and camel, found abundant forage. This great herbivore diversity supported a corresponding wealth of carnivores such as the saber-toothed cat, short-faced bear, and American lion, all of which were dependent upon and specialized for predation on large mammals. Dire wolves were among these, having also specialized as hunters of large game, and they were probably as finely adjusted to the habits and abundance of their prey as the herbivores in turn were to the stable glacial period ecosystems.

With the end of the Wisconsin glacial period, relatively slower reproductive rates probably helped doom large ungulates and many other Pleistocene mammals to extinction because they could not reproduce quickly enough to account for their accelerated mortality rate. Large and small Ice Age species, ultimately dependent on the stable glacial ecosystems and closely adapted to one another, may have been unable to adjust their diets, behavior, and reproductive cycles quickly enough to keep pace with the changing patterns of climate and vegetation. Although these glacial-interglacial transitions had occurred before, pollen and climatological findings show that the last one was unusually uneven.

As habitats and plant communities dispersed or disappeared altogether, large, slow-reproducing animals such as mammoths, horse, sloth, and camel died out, perhaps hastened in their extinction by the hunting activities of early man. This in turn also affected dependent predators that included the dire wolf. Unable to change its hunting habits and prey preferences fast enough, *C. dirus* numbers declined, which now created an opportunity for the gray wolf. In addition to already being adapted to preying on postglacial survivors such as deer and elk, the gray wolf's mobility and wide-ranging habits would have allowed it to repopulate the dire wolf's old territories quickly. Now faced with added competition from its cousin, dire wolf populations gradually dwindled, although some of the ancient form's genes may have been passed on through isolated interbreedings as the gray wolf became more common and its range became more extended. The last fossil occurrences of the dire wolf date from about 9,440 years ago at Brynjulfson Caves, Missouri, and a possibly later find of about 8,000 years from Devil's Den, Florida. Coyotes, now ecologically too close for comfort to the gray wolf, withdrew to the plains and arid regions of the West, leaving the northern forests and woodlands to its rival until the coming of man.

Animal artist and author Mark Hallett combines his skills at documenting the ancient past with photographic illustrator Veronica Tagland to re-create the world of extinct life and to publicize the plight of endangered living animals and their habitats. The author wishes to express thanks to Dr. Blaire van Valkenburgh for her assistance in reviewing this article.

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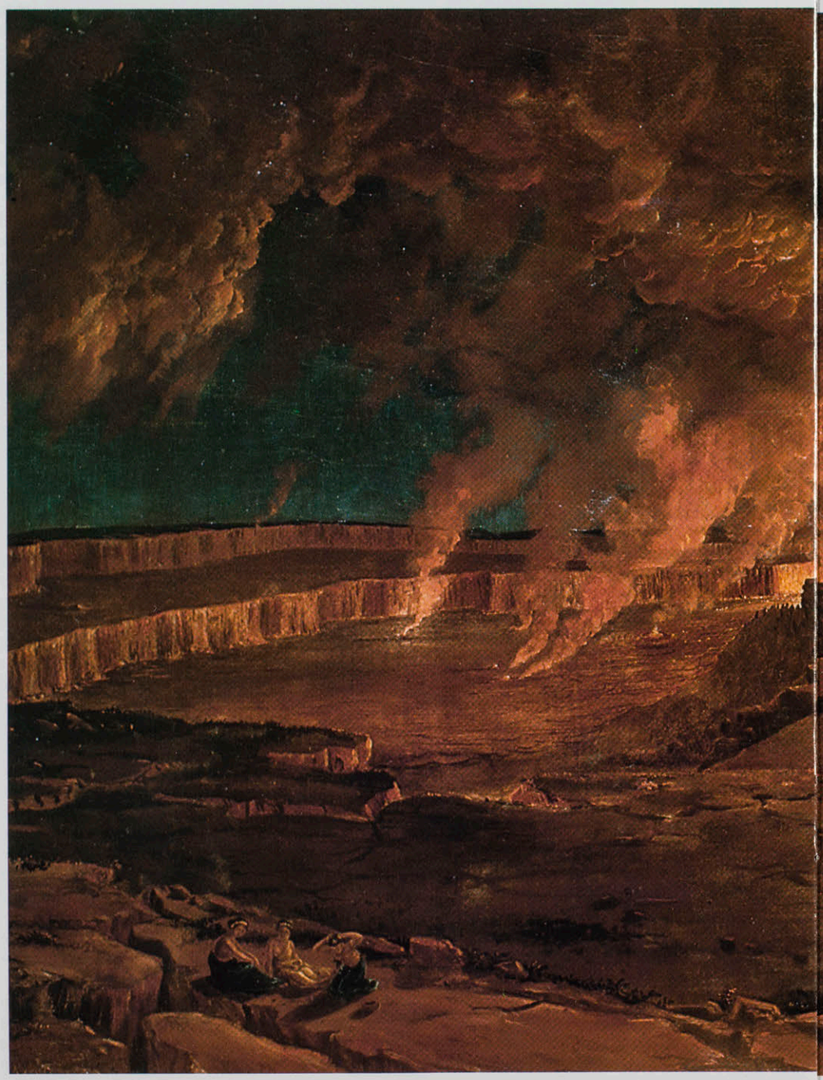
MAGNIFICENT VOYAGERS
The Story of the U.S. Exploring Expedition, 1838-42
Part II

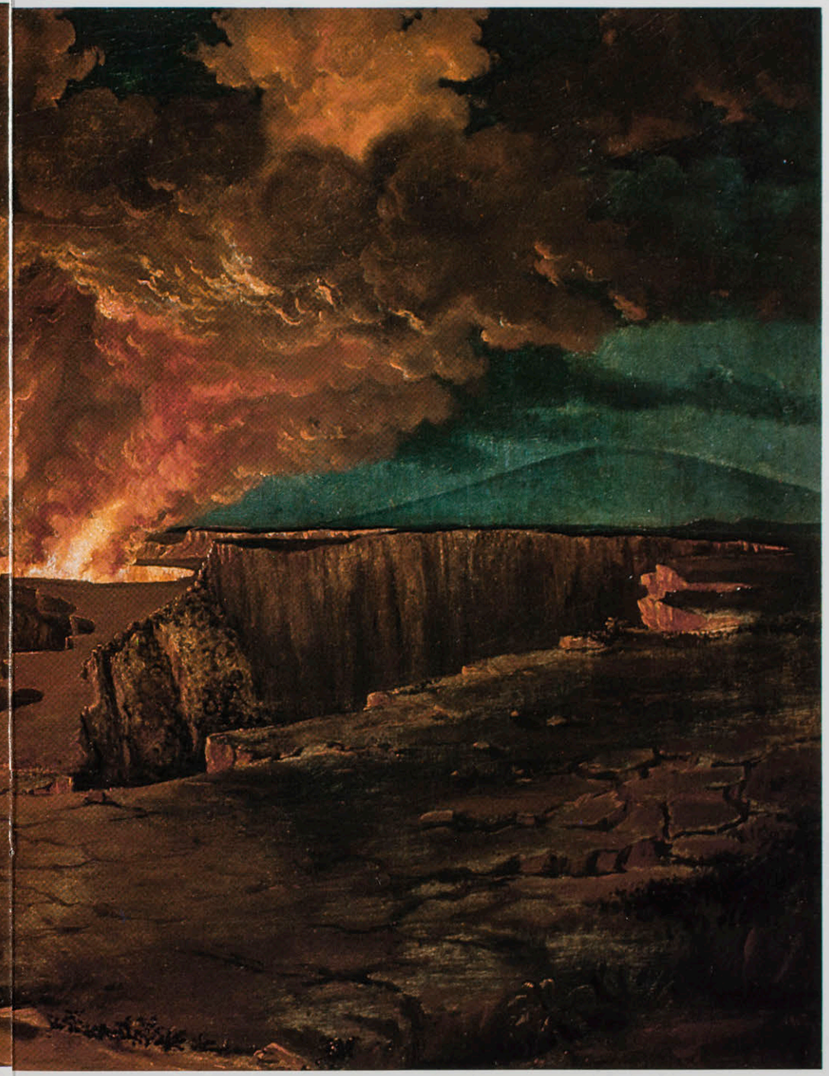
by HERMAN J. VIOLA

Under the command of Lt. Charles Wilkes—who may have been a model for Moby Dick's driven Captain Ahab—six ships set sail to explore the world and what it had to offer to the young and burgeoning United States. The idea for a federally sponsored exploring expedition originated to test a bizarre theory that the world was hollow. However, New England whaling and other commercial interests were eager for a survey of the oceans' resources and the U.S. Navy was anxious to show the Old World that a new naval power was afloat on the seven seas.

For four years a complement of young naval officers, sailors, and "Scientifics," a civilian corps of scientists and artists, circumnavigated the world, enduring great hardship and danger as they explored Anarctica, the Pacific Islands, and the then-largely unknown Oregon Territory. The extensive collections of specimens gathered on the voyage became the foundation for the Smithsonian Institution, and maps prepared by the expedition were in use even during World War II.

Magnificent Voyagers: The U.S. Exploring Expedition 1838–42, an exhibition telling the story of the expedition, is sponsored in Los Angeles by ARCO and Occidental Petroleum and will be on display in the Natural History Museum's Governor's Gallery through August 30, 1987. No special tickets are necessary for this exhibition.





Despite Wilkes's best efforts, the Expedition's ships were unable to sail to Antarctica together. The first one to become separated was the *Flying Fish*, which, unable to keep up with the larger vessels, disappeared during a dense fog. The small pilot boat was not seen again until after the Antarctic cruise and was assumed to have suffered the same end as the *Sea Gull*, which had disappeared on the way to Valparaiso, Chile, earlier in 1839. Eventually, all the vessels became separated, causing many men on board anxious thoughts about each other's fate.

It was the *Peacock*, however, that came closest to a watery grave. On 23 January 1840, it went stern first into an iceberg and broke its rudder and parted the starboard wheel rope. Unable to be steered, the vessel drifted into a huge ice island and broke its stern davits, stern boat, and spanker boom. At the same time it became trapped by floating ice. Providentially, a narrow channel opened and Captain Hudson and the crew, after more than twenty-four hours of constant labor, literally pulled the stricken vessel through it into open water. Reynolds later described the effort for his family: "We toiled, toiled on, 'never say die' was the word—even the boys worked, with all the ardor of Hercules." Although the rudder was repaired, the *Peacock* had to return to Sydney.

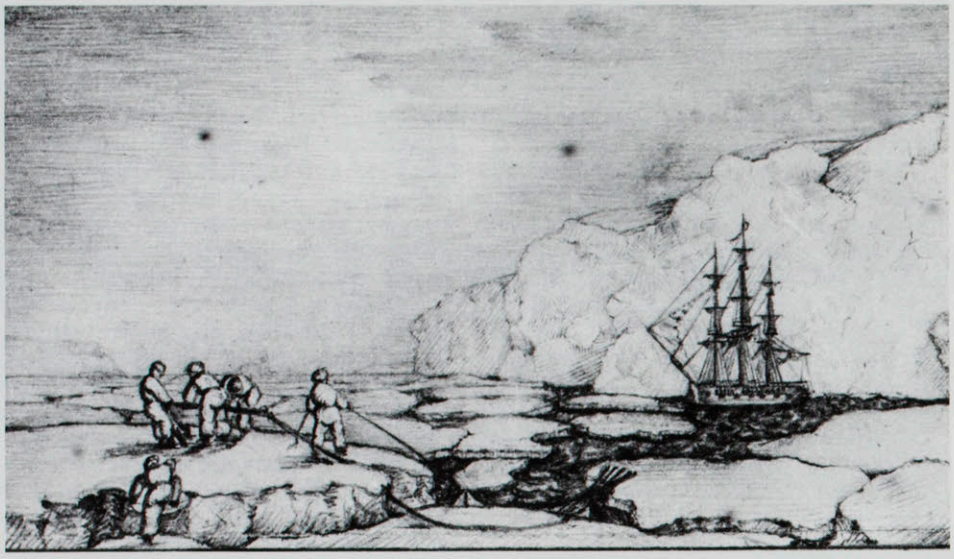
Despite its bad luck, the *Peacock* gets credit for the Expedition's first landfall. The episode, however, also proved to be the most controversial aspect of the Expedition. Although the landfall was officially recorded in the log of the *Vincennes* on 19 January 1840, the discovery was actually made several days earlier—on 16 January—when Midshipmen Henry Eld and Reynolds from the rigging of the *Peacock* reported distant mountains. To their dismay, the fact was not recorded in the ship's log.

This later proved to be a serious omission because a French exploring expedition under Admiral Dumont d'Urville was in approximately the same waters at the same time and recorded making a landfall on 19 January, the same day as Wilkes. To compound Wilkes's problems, his claims for discovering the Antarctic continent—based on sailing along fifteen hundred miles of the Antarctic coast and declaring the large mass to be a continent—were later contested by James Clark Ross. The British explorer had a chart of the American discoveries, which Wilkes had sent him, and reported having sailed right over the position of Wilkes's "pseudo-Antarctic continent."

Recent scholarship, however, has vindicated Wilkes. Two Australians, B. P. Lambert and Phillip G. Law, made detailed studies of the Antarctic coast and found a striking similarity between their calculations and those of Wilkes. To achieve a fit between the Wilkes chart and their own they simply shifted his features 116 miles to the south and 18 miles to the west. They pointed out that the errors in navigation and observation were understandable given the instruments of the day and Antarctic conditions. The miracle, scholars have noted, is that Wilkes could have been as accurate as he was. Perspective is often distorted by dense clouds of snow that blow over the sea from the mountains of Antarctica and by the heavy fogs that mask the land. Furthermore, mirages are frequent, making distant objects appear near. The tricks played by Antarctic temperature inversions are now better understood. In such situations a layer of warmer air above that hugging the icy surface bends light rays and causes a feature more than a hundred miles away to appear near at hand. This, the Australians believe, accounts for the large error in latitude in the Wilkes map.

Another dramatic moment occurred on 30 January 1840, when the *Porpoise* unexpectedly met two French vessels off the coast of Antarctica. The *Porpoise*, separated from the rest of the squadron, assumed they were the *Vincennes* and the *Peacock* but raised the American colors upon realizing the mistake. When the strangers raised the French colors, including the broad pennant of a commodore, the Americans recognized the

James Dwight Dana, the expedition's geologist and most eminent Scientific, felt that the Hawaiian islands were the "key to Polynesian Geology." The Wilkes Expedition made the first accurate scientific studies of the active volcanoes Mauna Loa and Kilauea, one of the great scientific achievements of the expedition. Kilauea is shown erupting at night in a painting by Titian Ramsey Peale. Courtesy Bernice Pauahi Bishop Museum.



The U.S.S. Peacock, *a well-worn sloop of war, was one of six ships that set sail with the Wilkes Expedition. This pencil sketch of the* Peacock *caught in the Antarctic ice, drawn by the ship's doctor Charles F. B. Guillou, was sent by Midshipman William Reynolds to this family after the disabled vessel returned to Sydney. "Heavens! What a hideous death we escaped!" Reynolds wrote. Courtesy of Anne Hoffman Cleaver.*

vessels as the command of Dumont d'Urville. The *Porpoise* immediately changed course, hoping to intercept and communicate with the Frenchmen but broke off the attempt when it appeared they were trying to avoid a meeting. Unfortunately, the Americans had misinterpreted the French movements. Unduly sensitive about national honor and indignant at what each perceived to be the ill-mannered behavior of the other party, the French and American vessels went their separate ways.

The next major surveying task involved the Fiji Islands. There Wilkes investigated the murder in 1834 of ten crew members of an American ship by a Fiji leader named Vendovi, brother of the king of Rewa. To capture him, Lieutenant Hudson invited the king and his court on board the *Peacock* and then held them hostage until Vendovi surrendered, which he readily did the following day. Upon admitting his role in the murders, Vendovi was made prisoner and told he would be taken to America where, Midshipman Reynolds wrote his family, he would learn "that to kill a white man was the very worst thing a Fegee man could do."

Shortly after Vendovi was captured, Fijians on the island of Malolo attacked a very small surveying party that had gone ashore to purchase food. In the attack, two officers—Lieutenant Joseph Underwood and Midshipman Wilkes Henry, nephew of the commander—were killed. Learning of the incident, Wilkes organized a punitive assault in which the two principal towns on Malolo were destroyed and about eighty natives were killed. Wilkes buried the two slain officers on a secluded cay that he named Henry's Island; the island group, of which the cay was a part, he named after Underwood.

The Expedition remained in the Fiji Islands for three months. Despite the violence, the explorers were proud of the work done there. They corrected a number of errors on existing charts, and they made impressive additions to their growing collection of natural history specimens: Brackenridge estimated they had collected six hundred new plant species, while the corals obtained by Dana were to become the heart of the Smithsonian's coral collection, which is now among the finest in the world.

The explorers also learned firsthand about the existence of cannibalism, something about which they had heard many rumors but which they had generally discounted. The evidence was obtained by the *Peacock* during a visit to Naloa Bay in July 1840, when one of the natives in a group that came on board ship for a visit was seen eating the flesh from a cooked head. "Every one on the ship was affected with a nervous & terrible feeling of mingled horror & disgust," Reynolds recalled. Disgusted though they may have been, the Scientifics purchased the head for their collections.

The next destination was the Sandwich or Hawaiian Islands, where the squadron enjoyed a much-needed holiday after their traumatic experiences in Fiji. The most dramatic event of the Expedition's stay in Hawaii was a scientific foray to the summit of Mauna Loa. Wilkes led a party of sixteen Expedition members and two hundred porters assembled on the authority of King Kamehameha III in an arduous nine-day trip to the summit. Interestingly, the ruins of the Expedition campsite on Mauna Loa are the only known physical remains of the U.S. Exploring Expedition in the Pacific.

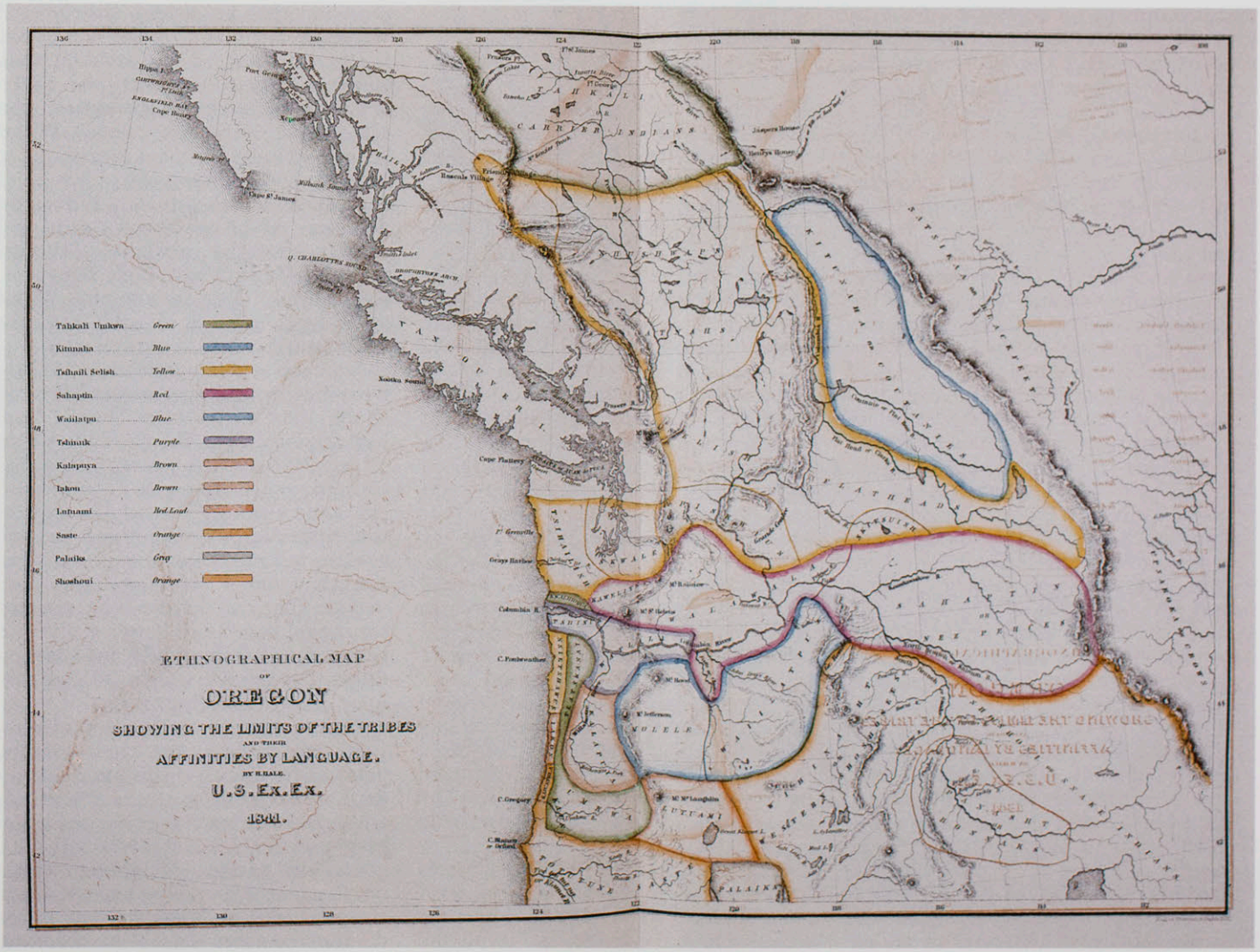
Although Dana, the geologist, did not accompany Wilkes to the summit of Mauna Loa, he nonetheless made a major contribution to geology through his study of volcanoes during the Expedition. His work on Kilauea on the island of Hawaii was a principal scientific result of the Expedition, and his account of caldera formation was of great importance in the history of volcanology. Furthermore, Dana extended his ideas about volcanism to igneous processes in general. While Wilkes was engaged on Mauna Loa, the rest of the squadron was surveying various island groups in the area. The *Peacock* and the *Flying Fish*, for example, visited the Marshall and Drummond (Tabiteuea) islands, where they had a fight with natives who had killed one of the Expedition's sailors.

The squadron's next major rendezvous was to be the mouth of the Columbia River on the northwest coast of North America. Once again misfortune hampered the explorers, for the *Peacock* foundered while attempting to enter the Columbia. The crew survived, but the ship and its scientific collections were lost. Despite this setback, much was accomplished. It was here that the Expedition produced its most important map, titled "Mouth of the Columbia River, Oregon Territory, 1841." When linked to the map of the Rocky Mountains prepared the following year by Captain John C. Frémont, it enabled the United States to establish a geodetic baseline for the territory between the Mississippi River and the Pacific Ocean. After conducting extensive surveys in Oregon, Wilkes sent a party of explorers overland to California (then still part of Mexico) and took the rest of the squadron, which now included a merchant vessel named the *Oregon*—purchased in Astoria as a replacement for the *Peacock*—to San Francisco, where the entire party was once again united.

The return voyage was anticlimactic. En route, the explorers visited South Africa after the Philippines and Singapore, where Wilkes sold the *Flying Fish* because it was no longer seaworthy. The decision, though probably wise, caused considerable regret. One officer thought it deserved "a place in our National

Wilkesia, *a distinctive plant (*iliau *to the Hawaiians) discovered on the island of Kauai and named for the expedition's commander. Multiple labels on this specimen result from its continuing use in botanical research. Courtesy National Musem of Natural History, Smithsonian Institution.*

Maps and nautical charts were two of the most important contributions of the Wilkes Expedition to American science; some of the nautical charts created by the expedition were used as late as World War II. This hand-colored map shows the distribution of Northwest Territory Indian tribes. It was based on interviews with Indians and with officers of the Hudson's Bay Company. Courtesy of the Smithsonian Institution Libraries.



RADIANT DARKNESS
The Many Facets of the Caves of Jamaica

by DONALD A. McFARLANE

Driving south from Spanish Town across the flat expanses of sugar cane, the vista is broken by a line of low, unimpressive hills known as the Portland Ridge. Closer inspection does little to change this uninspiring aspect, and yet beneath the harsh mantle of tangled thorn scrub and razor-sharp limestone lies one of the jewels of Jamaica—a complex of caves resplendent in their beauty, unique in their scientific wealth, and respected for their sporting challenge.

The seven kilometers of caves presently known lie to the east of the fishing village of Jackson's Bay on the southwestern edge of Portland Ridge. The area lies in the rain shadow of Jamaica's spectacular Blue Mountains, and the resultant climate is harshly arid and quite unlike the lush tropical forests to the north. Indeed, the botanist M. Seifriz wrote of these circumstances "The heat is intense, the light blinding, every plant armed, no water, no shade, no trail leading anywhere, as awe-inspiring, as fearful, as superb a picture of the eternal persistence of life under the most adverse conditions as nature can produce." Incredibly, despite the tangle of thorned vegetation, there is no soil on Portland Ridge—the ground is a honeycomb of dissected limestone blocks and eroded razorlike stone blades between which plants compete for space in the moist darkness of fissures and sinkholes.

The harshness of the surface environment belies the long history of habitation along the periphery of Portland Ridge. The area is known to have been home to a small population of Arawak Indians in pre-Colombian times, who survived on a diet of shellfish and fish and who drew fresh water from the caves. Later, with the development of sugar estates to the north, small communities of slaves or their descendants became established.

The earliest written account of the Jackson's Bay caves was published in 1897 as a description of archaeological finds. In the early 1950s the Jamaican Geological Survey Department investigated parts of what subsequently came to be known as Jackson's Bay Great Cave, but did not realize the extent of the caverns. Serious exploration began in 1964 when members of the Jamaica Caving Club (JCC) were led by local inhabitants to several entrances to the Great Cave and also Arrow Cave and Somerville Cave higher up the hillside. Since that time a dozen separate but interrelated caves totaling more than seven kilometers of passage have been explored and much more undoubtably awaits discovery.

A number of animals make their homes in the caves, some unique to science. The brackish waters of the Great Cave, which are presumed to have an obstructed connection to the sea nearby, are home to a significant population of intimidatingly large cave crabs. A blind white cave fish has also been seen on at least three occasions, but has never been scientifically described. Deep in the system and close to the very beautiful "Little People" grotto, a blind white crustacean has been discovered that occurs nowhere else in the world.

Perhaps surprisingly, bats are not particularly prolific residents of the caves. Groups of a dozen or so are often encountered close to entrances or hanging from the tips of stalactites, but the enormous legions that are common in caves elsewhere on the island (see "The Rat Bat Caves of Jamaica," TERRA, January/February 1985) do not occur at Jackson's Bay. The reason seems to be the aridity of the surface environment. To the north, large bat colonies make their nocturnal exodus into a landscape of lush forests and rushing streams that teems with large insects, tropical fruits, and nectar-rich flowers. On Portland Ridge the ubiquitous clouds of voracious mosquitoes are less desirable prey for large insectivorous bats, and the wild-fig trees that are a staple for fruit bats are much less common.

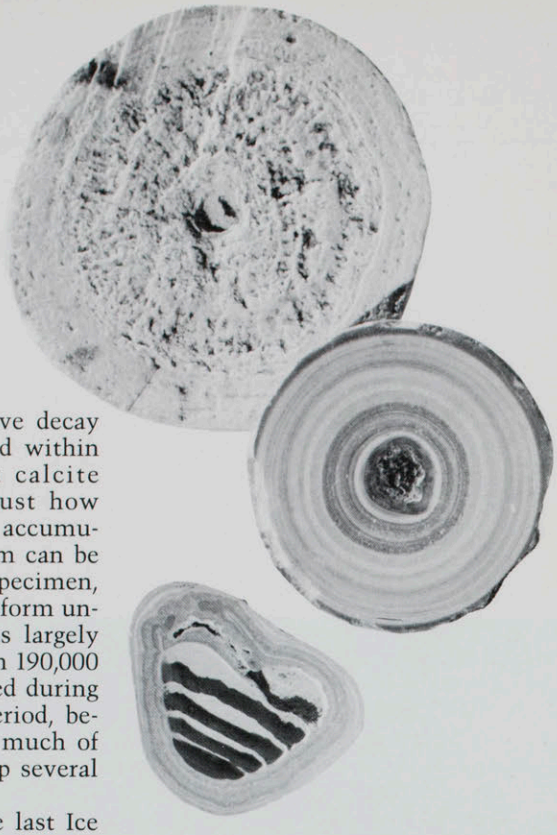
In 1978 a group of JCC members were prospecting in the lower, flooded corners of the Great Cave. Fortuitously, they discovered a tortuous concealed passage—barely wide enough for a human body—that led them into a series of large passages and chambers beyond. Opening into one of these chambers was a narrow, previously unknown ninth entrance to the Great Cave complex. Unexpectedly, the spacious chamber was almost filled with an enormous accumulation of bat guano. The guano was not the moist, fresh guano of caves elsewhere on the island, but instead had composted to form a rich, soft organic soil. There was no doubt in anyone's mind that the guano was very old—unmistakable evidence of a former major bat colony.

Bat guano is prized in Jamaican agricultural communities as a superb natural fertilizer and provides a much-needed source of income for the farmers who mine it. As a result, the known and accessible deposits across the islands have long since been mined away and their scientific value lost. Since the Great Cave deposit was undisturbed and the former bat entrance completely unknown to locals, it was certain that the bat colony had not been lost through human disturbance. It was also clear from a decade of exploration in the area that the colony had not simply relocated. The question then, was, what had happened? The answer was to lie not in the guano chamber of the Great Cave, but in the calcite wonderland of Drum Cave.

Drum Cave is a higher-level component of the Jackson's Bay cave complex well above the water table and now completely dry. Two collapse pits deep in the scrub forest lead directly into enormous subterranean tunnels of outstanding beauty. Most people are familiar with the commonest of calcite speleothems, the stalactites and stalagmites that grow from roof and floor respectively and occasionally unite as columns. These formations occur in profusion in Drum Cave, but the cave is renowned for a much rarer jewel, the cave pearl. Cave

The author admiring a rimstone in the Water Cave, Jackson's Bay, Jamaica. Photograph by R. Gledhill.

The author in Drum Cave, Jackson's Bay. Cave pearls, formed when calcite-charged water falls into shallow pools, litter the floor. Photograph by R. Gledhill.



Jamaican cave pearls. The pearls have been sectioned to illustrate their concentric structure. The smaller pearl has a land snail as its nucleus. Photograph by John De Leon.

with brackish water. The entrance to this section is an impressive cathedral-like portal that must have inspired the Arawaks as much as it has inspired generations of later explorers. Just inside, bathed in the shifting twilight, the Indians carved geometric patterns and crude, round faces into the soft stalagmite flows. Whether these symbols had religious significance is completely unknown, but they remain today as eerie sentinels over the entrance to a little-known netherworld.

Somerville Cave is one of the more remote of the known caves and is reached by an arduous hike to its entrance pit. The pit is a wide, crater-like feature with undercut walls that drop as much as sixty or seventy feet to the flanks of a cone of bouldery debris below. Descending this talus cone in 1985, Richard E. Gledhill, a member of the British Cave Research Association, noticed an unusual bone protruding from the rocks and gravel. Bones are common in these pits because the steep walls are favorite roosts for barn owls, which regurgitate the skeletal remains of their prey and create veritable charnel houses of rodent, bat, and bird bones. However, the bone that attracted attention in the Somerville entrance pit was quite different, and it turned out to be human. Although a proper archaeological dig was not possible at that time, the bone and a number of others that had been exposed by erosion and were at risk of being lost were gathered up and moved to a protected alcove. Apparently, the remains were of two adults and a juvenile and were associated with several fragments of distinctive Arawak pottery. Whether the remains are those of Indians who fell to their death in search of water, or whether they were buried in the cave for ceremonial reasons, will have to await future discoveries for an answer.

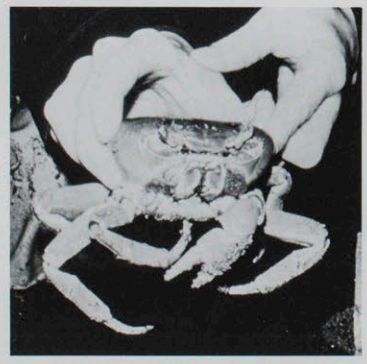
The caves that have yielded precious clues to the archaeological past were old millennia before the first men walked on Jamaica. In an attempt to learn just how old, a small piece of stalagmite from a passage in the Great Cave was removed and submitted to a sophisticated analysis called uranium-series disequilibrium dating. The technique is based on the idea that uranium is present in very small quantities in most limestone percolation waters, but the products of uranium's natural radioactive decay only accumulate when trapped within the crystalline matrix of a calcite speleothem. By measuring just how much of these products have accumulated, the age of the speleothem can be determined. The Great Cave specimen, which could not have begun to form until after cave development was largely complete, proved to be between 190,000 and 250,000 years old. It formed during the penultimate interglacial period, before the last Ice Ages cloaked much of North America with an ice cap several kilometers thick.

Since the caves predated the last Ice Age, the potential exists for their sediments to preserve an important record of the fauna of Jamaica that existed during that time of global climatic upheaval. Excavations beneath the cave pearl pools of Drum Cave have revealed an unusual sequence of stratified sediments almost five feet thick containing the scattered remains of bats and rodents. The significance of these finds cannot be judged until the results of radiocarbon and other dating studies are in, but if the sediments do indeed prove to date from the last Ice Age or earlier, they may provide a unique key to Jamaica's distant past. To date, the study of the many facets of the Jackson's Bay caves has advanced without the benefit of an integrated historical framework. Now, with the application of modern dating techniques, the potential exists to weave geology, biology, archaeology, and paleontology into a fabric of palaeoclimatic change for which the caves will be recognized as a scientific repository of enormous value.

The labyrinthine world of the Jackson's Bay caves has been slow to yield up its secrets. Some have now been resolved, others are the subject of ongoing research. Few of us who have worked in the radiant darkness of these caves doubt that much, much more remains to be discovered.

Don McFarlane is a Fellow of the Royal Geographical Society, coordinator of bat conservation activities for the National Speleological Society, and an inveterate Englishman. Currently a graduate student in the Section of Mammology, his research interests focus on the ecology and biogeography of tropical bats.

A cave crab, Jackson Bay Great Cave. A crab of this size can be very intimidating to the spelunker exploring a narrow passage. Photograph by D. McFarlane.



MUSEUM ON THE MOVE

Page Museum Celebrates Tenth Anniversary. Two special April celebrations marked the start of the Page Museum's second decade. On the morning of April 10, 1987, George Page accepted an official scroll from the Board of Supervisors declaring "George C. Page Museum of La Brea Discoveries Day" and a plaque from Los Angeles City Councilmember John Ferraro. Page shared a Smilodon birthday cake with the school children touring the museum, who signed a giant tenth birthday card.

On April 11, the Page Museum Tour Guides Association honored George Page at a luncheon in the museum. Balloons decorated the hallway and classroom and another birthday cake was served. The tour guides, who receive wonderful letters from children who visit the museum, selected their favorite letters to read aloud. Page was presented with a folder full of special birthday wishes sent by recent visitors.

Bringing a museum into existence is no small task, according to Page. The project stemmed from his early conviction that the fossils belonged at the tar pits in Hancock Park. Persuading the Los Angeles County Board of Supervisors and the Natural History Museum that his project had merit was only the first step. Page found architects with the skill and vision necessary for the challenge. He tracked down exhibit designers and artists to create entertaining and informative displays; guided a construction process complicated by the presence of naturally occurring asphalt; and contended with protests that the museum would rob the city of green space. Page's determination to use the best talent available and his personal oversight of every detail brought the museum from groundbreaking ceremonies to opening celebration in just under two years.

The Page Museum is fortunate to have a small but dedicated staff and a legion of active volunteers. Staff members Bert Bergeron and Barbara Parkhurst have been involved with education programs and school tours at the La Brea site since 1969, while scientific staff members Shelley Cox, Mary Romig, and Chris Shaw started working at the tar pits in the early 1970s. Museum Superintendent Greg Byrd and paleontology curator George Jefferson, both of whom had worked at the Natural History Museum, were active during the development of the Page Museum.

Volunteers Ruth Aaron, Ellen Bernick, Joe Carroll, Ruth Cohen, Ed Cronin, Lynne Cruise, Jean Dittrick, Alice Garrett, Del Gillingham, Nan Hammond, Terry Kagan, Hiruko Kawasaki, Beverly Levitt, Sandy Liebman, Jeanne Mayer, Sally Rubin, Roy Salls, Richard Sapiro, and Mary Alice Zeman were all active La Brea volunteers when the Page opened and have maintained their association with the museum. Since April 1977, these and other volunteers have donated 187,316 hours of support to Page Museum activities.

Discovery Center Opens. Three special events marked the opening of the Ralph M. Parsons Discovery Center in the restored north wing of the museum's original Spanish Renaissance building.

On Wednesday, April 8, the press preview attracted representatives from all major print and electronic media and from specialized publications for children and families. Children from the 32nd Street School were greeted by favorite cartoon characters, dispatched for the occasion by the Mattel Foundation, which also sponsored the center's Discovery Boxes. After giving the center's displays and activities their first workout, the children enjoyed milk and cookies donated by Carnation Company and Famous Amos.

On Saturday, April 11, the museum's Trustees and Alliance Board were invited to preview the Discovery Center, with the provision that "adults must be accompanied by a child." These special supporters of the museum, who had closely followed the Discovery Center's progress from the initial concept to fruition, learned first-hand that the center's activities appeal to adults as well as children. In the spirit of the event, refreshments included pizza, corn dogs, hot pretzels, and do-it-yourself potato-skin and ice-cream sundae bars, imaginative food prepared for the museum by Somerset Caterers.

On Monday, April 13, the museum held this year's second special membership event for its general membership. (The first was the popular annual Open House, in January.) From 1 to 8 p.m., over 150 member families "discovered" the Discovery Center's attractions.

Construction of the Discovery Center began in May 1986 under a generous grant from the Ralph M. Parsons Foundation. Parsons's dedication to enhancing science education for young people was rewarded as the center's hands-on, multisensory learning experiences in history and the natural sciences drew rave reviews from each preview audience.

Dick Meier

George C. Page and Mrs. Merle Kingsley at the Golden Edition of the Dinosaur Ball.

1987 Dinosaur Ball a Golden Success. Imaginative ideas, careful planning, and long hours of preparation made the "golden edition" of the Dinosaur Ball a glamorous evening for party-goers and a successful fund-raiser for the museum. The Alliance Board of Directors and Museum Director Craig C. Black chose the occasion to honor George C. Page for his generosity of spirit in support of the programs of the Natural History Museum.

The Dinosaur Ball Committee, headed by Chairman J. Shelton Ellis, Jr., surprised guests with a number of special additions to the format of the popular annual event.

Guests walked down a gold-glittered path, entering the museum's original Spanish Renaissance building to fanfares by trumpeters in Medieval costume. Inside, they found violinists serenading from the balcony of the rotunda. Cock-

tails and hors d'oeuvres were served in the Ralph M. Parsons Discovery Center, where an animated model of a baby brontosaurus roared a welcome. The party-goers then moved to the four habitat halls, where Rococo served an elegant dinner on gold lamé-covered tables under glittering chandeliers.

After dinner, guests danced to Ron Rubin's orchestra in the main foyer, transformed with orchids and golden "rain" in the form of tiny tracer lights suspended from the ceiling. A neon dinosaur created by the museum's audio-visual expert, Rich Young, nodded its head and waved its tail above the dance floor.

Betty Reddin, Chairman of the Alliance Board of Directors, called the 1987 Dinosaur Ball "the best party in town." Now in its fifth successful year, the Dinosaur Ball was initiated by the Alliance Board to support the exhibitions and education programs of the Natural History Museum. This year, the board exceeded its goal of $260,000.

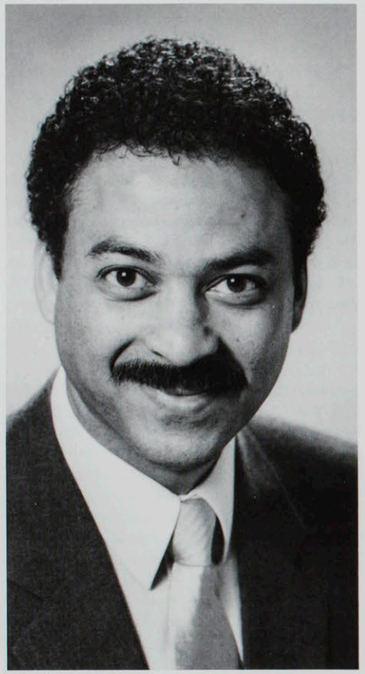
Petersen Appointment Announced at Bird Hall Reception. Robert S. Attiyeh, President of the Natural History Museum Foundation Board of Trustees, announced the election of Robert E. Petersen to the Board of Trustees at an April 15 reception for the Great Bird Hall.

Petersen, Chairman of the Board of Petersen Publishing, controls one of the last independent magazine publishing houses in the nation. An avid sportsman, he is active in Ducks Unlimited and the Safari Club. His association with the museum began when Petersen Publishing became a member of the Business Associates, a distinguished group of corporations that support the museum's Annual Fund. Petersen combined his philanthropic and recreational interests by making a leadership gift to the Great Bird Hall.

"We are proud to welcome Bob Petersen to the Board of Trustees," said Attiyeh, noting that Petersen represents a classic example of the American dream. "He dedicated himself to personal advancement through creative management and works diligently on behalf of programs that benefit mankind."

Petersen started his business in his garage, publishing *Hot Rod Magazine* on an initial investment of $200. Today, he controls a $200 million enterprise, the largest magazine publishing company on the West Coast.

Dick Meier



Romalis J. Taylor

Museum Welcomes New Deputy Director. Romalis J. Taylor has joined the Natural History Museum as Deputy Director of Administration. He will be responsible for operations and administration in the areas of finance, personnel, security, general services, and facility maintenance and will also provide staff support to the museum's capital campaign.

Taylor attended California State University at Los Angeles, working for a Master's degree in Public Administration. His undergraduate degrees are in Industrial Studies and Computer Technology. He comes to the museum from his position as Principal Administrative Analyst in the Finance Division of Los Angeles County's Chief Administrative Office (CAO). There he conducted complex organizational and management studies and analyzed the budget requests of various county departments, making funding recommendations to the Chief Administrative Officer. Taylor was a member of the CAO's task force that recently recommended creation of a new transit authority for Los Angeles County. His experience in county administration will be of significant value to the museum.

CURATORS & COLLECTIONS

Natural History Museum Pioneers Training in the Care of Natural History Collections. Our natural science collections are at constant risk from a suite of potentially harmful factors. These include damage by insect (and human) pests, molds, and pollutants, and more subtle but equally insidious damage from microclimate fluctuations in poor storage environments and the interactions of materials used in specimen preparation and storage. Added to these risks is the critical need to preserve data associated with each specimen in a collection. Then add major institution-wide risks such as fire, flood, and earthquakes, and the ever-present conditions of underfunding and understaffing. Considering all this, we must marvel at our qualified successes at preserving our present collections, but are also constantly reminded of the urgent need to critically, carefully, and comprehensively address the problems of specimen care and conservation.

Training in the care of natural history collections for curators, collection managers, curatorial assistants, and technicians has generally been the haphazard by-product of hand-me-down teachings within a discipline picked up on the job or during a college career. No formal curriculum for training in the care of natural history collections has ever been developed, a disturbing situation that recently attracted the attention of several national museum organizations: the National Institute for the Conservation of Cultural Property (NIC), the American Assocation of Museums (AAM), and the American Association for State and Local History (AASLH). In 1985 the Bay Foundation of New York made a commitment to fund a series of pilot training programs in collections care, treating art, history, anthropology, and natural history collections.

The Natural History Museum of Los Angeles County competed with other major institutions and was awarded a three-year $105,000 grant from the Bay Foundation to develop a curriculum to teach collections care in the natural sciences and to conduct two pilot training programs: one in 1987 and the other in 1988. This year's Collections Care Pilot Training Program (CCPTP) consisted of a three-week session in February and March 1987, home-institution projects selected by each participant, and a week-long follow-up in early May. Kimball Garrett and Lynn Barkley, from the Natural History Museum's Section of Birds and Mammals, coordinated this experimental project. During 1986 they worked with several consultants who brought a diverse range of expertise in the developing field of natural science collections care: Carolyn Rose (Director of the Anthropology Conservation Laboratory, National Museum of Natural History), Catharine Hawks (Research Associate, Division of Mammals, National Museum of Natural History), Stephen Williams (Collection Manager, Section of Mammals, Carnegie Museum of Natural History), Robert Waller (Conservator, Mineral Sciences Division, National Museum of Natural Sciences, Canada), Mary-Lou Florian (Conservation Scientist, British Columbia Provincial Museum), Benita Johnson (Training Program Coordinator, Getty Conservation Institute), and Stephen Weintraub (Head of Conservation Processes, Getty Conservation Institute). Most of these consultants were also involved in the training sessions; additional instruction was provided by the staff of the Natural History Museum of Los Angeles County, Dr. Prem Notani-Sharma of L. A. County's Environmental Health and Safety Services Office, Captain Dennis Stangeland of the L. A. County Fire Department, Robert Combs of the J. P. Getty Museum security staff, Lloyd F. Kiff of the Western Foundation of Vertebrate Zoology, and Vernon Underwood of the USC Radiation Safety Program.

Emphasizing awareness, the teaching curriculum revolved principally around the major themes of documentation and of viewing collections as complexes of materials that interact with each other and with their environment. Treated in detail were the inorganic and organic materials contained in collections, the understanding and monitoring of the collection environment, common-sense approaches to collection storage, and a variety of health, safety, and disaster-planning issues.

The 1987 program's fifteen participants were selected for their commitment to collections care and the likelihood that training could have an immediate effect within their own institutions. They hailed from all over the United States and from Canada, Bermuda, and Mexico, representing small regional museums and such major institutions as the National Museum of Natural Sciences in Canada, the Academy of Natural Sciences at Philadelphia, and the Bishop Museum in Honolulu. From diverse backgrounds but sharing a common set of problems, the participants were enthusiastic, eager, and quite knowledgeable in their own right in a field without any experts. Through group discussion and interactions with the consultants and the Natural History Museum staff, they worked hard to achieve maximum results from an intense and exhilarating training schedule.

The second program will be offered in early 1988. Following that program, a detailed written curriculum will be compiled in a joint effort with the NIC and other sponsoring organizations. This document is intended to be the basis for future, on-going regional training programs. This is a bold and innovative beginning that will both stimulate and feed upon developing expertise in the care and conservation of collections.

We are grateful to the NIC, the Bay Foundation, and the other backing organizations for their vision. The program coordinators and their administrative assistant, Roberta Harma, would like to thank the numerous staff members at the Natural History Museum of Los Angeles County who worked hard to ensure that the program ran smoothly. The benefits of the Collections Care Pilot Training Program to the participants' home institutions and here at the Natural History Museum of Los Angeles County have been immediate and substantial, manifesting themselves in enhanced awareness and changes in policy and procedures. With this beginning, and with other recent developments such as the establishment of the Society for the Preservation of Natural History Collections, the future for collections care, even in the face of continued budgetary cutbacks, is becoming increasingly bright.

Natural History Museum Research Associate Assists in Efforts to Conserve Migratory Monarch Butterfly. State Assemblyman Byron Sher (Democrat, Palo Alto), working with Chris Nagano, Research Associate in the Entomology Section, and Walter Sakai of Santa Monica College, has proposed legislation that will be a significant step toward conserving the California wintering colonies of the Monarch butterfly (see "The Migration of the Monarch Butterfly: An Uncertain Future," by Gary Wolfe and Chris Nagano, in the September/October 1986 issue of TERRA). Each fall the Monarchs of North America migrate to their roosts located in central Mexico or along the California coast. The Mexican sites are threatened by logging for lumber or firewood. Poorly planned development has destroyed colonies in California.

Assemblyman Sher has introduced Assembly Bill 1671, which calls for the recognition of the unique phenomenon of the California wintering roosts and directs the Department of Fish and Game to inventory and map the location of the sites as well as prepare recommendations for their management. According to Walter Sakai, "effective conservation of all wildlife species is dependent upon adequate and accurate information." He notes that passage of AB 1671 will make

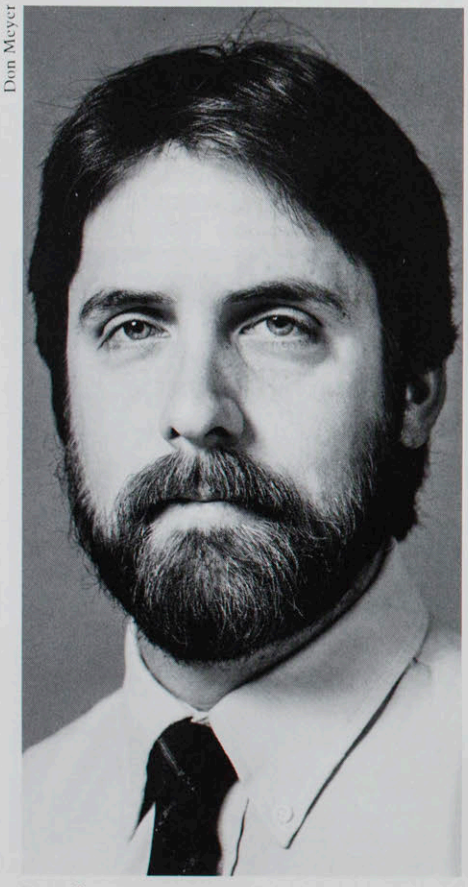
Chris Nagano

Chris Nagano and Walter Sakai tagging Monarch butterflies.

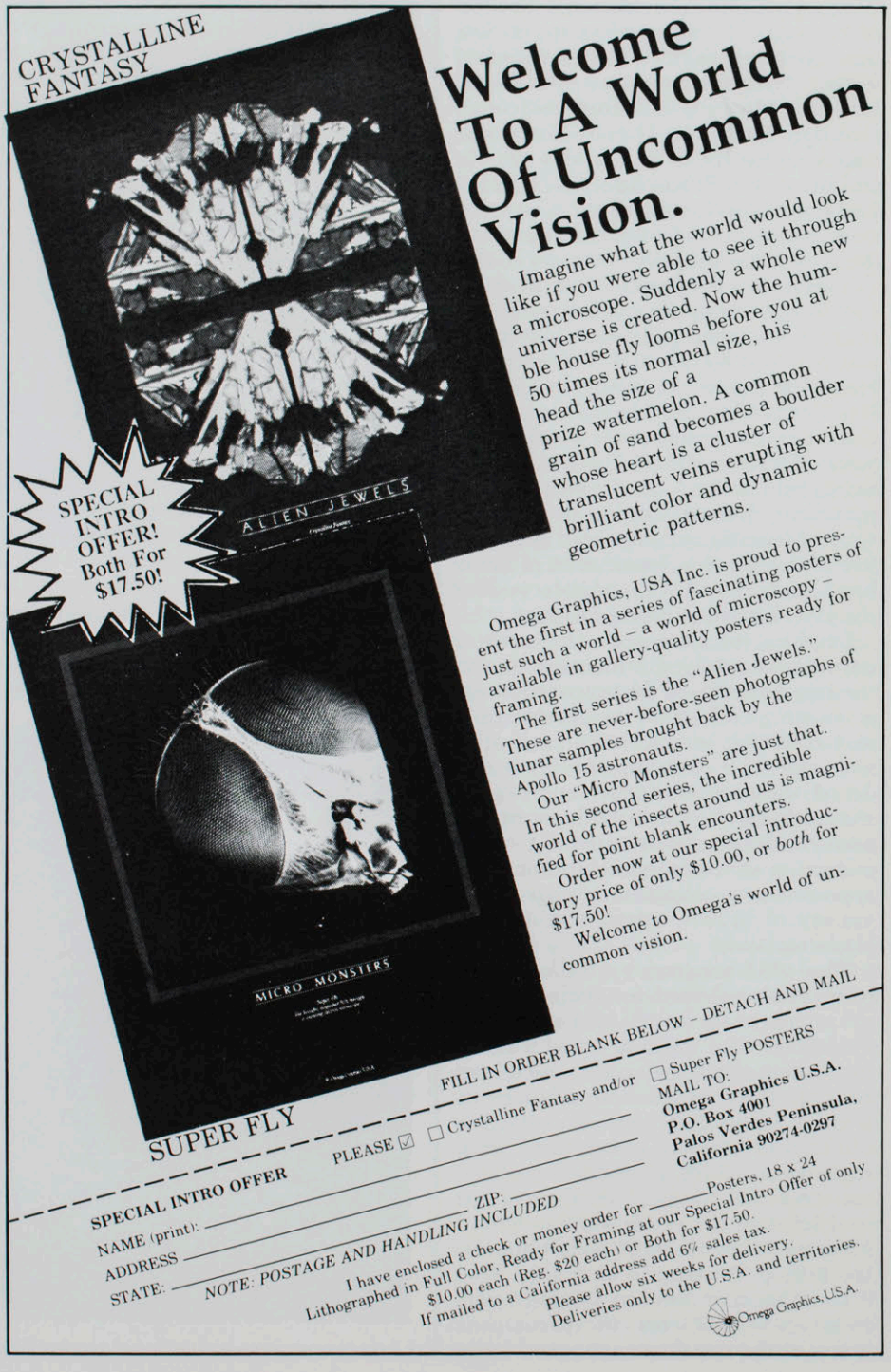
a tremendous amount of data on the Monarch readily available to interested government agencies, private organizations, and citizens. Nagano emphasizes that the presence of a colony does not necessarily exclude development of a site. Often, modifications of the plans will allow continued use of the locality by the wintering butterflies. "The proposed efforts by the State of California," said Assemblyman Sher, "will help to ensure the Monarch will continue to grace the fields and gardens across North America for decades to come."

Dr. John E. Heyning, New Marine Mammalogy Curator. Dr. John E. Heyning is the Natural History Museum's new Assistant Curator of Mammals. His curatorial duties will include curation of the Natural History Museum's large-mammal collection (including marine mammals), which is stored in an off-site warehouse. Dr. Heyning has for several years coordinated the scientific collection of stranded whales and dolphins in the Los Angeles and Orange County areas and will continue to do so in his new capacity (see the article he authored with Judith Chovan, "Wanted Dead or Alive: The Natural History Museum's Marine Mammal Stranding Program," in the January/February 1987 issue of TERRA). His research interests include the comparative anatomy and systematics of whales and dolphins, with an emphasis on the rare beaked whales. He has previously traveled throughout the North Pacific studying whales for the National Marine Fisheries Service and has led the Natural History Museum's trips to Kenya, Baja California, and the Antarctic. Dr. Heyning recently received his doctorate in Biology from UCLA.

Don Meyer



Dr. John E. Heyning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John De Leon

Jennifer Edwards

Jennifer Edwards, New Science and Serials Librarian. Jennifer Edwards has joined the staff of the Natural History Museum's Research Library as the Science and Serials Librarian. She received her B.S. in Biology from Marquette University in Wisconsin and her Master of Library and Information Science degree from the Graduate School of Library and Information Science, University of Wisconsin—Milwaukee. Ms. Edwards will be primarily responsible for cataloging and control of the Research Library's extensive journal collection, which now numbers over 3,500 titles.

History Division Publications Award. Dr. Harry Kelsey, Head of the Natural History Museum's History Division, has received the Bolton Award for the Best Spanish Borderlands article in 1985–86. Dr. Kelsey's article, "Finding the Way Home: Spanish Exploration of the Round-Trip Route Across the Pacific Ocean," was published in Volume XVII of the *Western Historical Quarterly.*

Curator Receives John Randolph Haynes and Dora Haynes Foundation Grant. Dr. Thomas Sitton, Assistant Curator and Section Head of the Social History Section, has received a $5,800 research grant from the John Randolph Haynes and Dora Haynes Foundation to support a biography of John Randolph Haynes that Dr. Sitton has been writing. Dr. Haynes, a physician, was a wealthy political and social reformer in Los Angeles from 1887 until his death in 1937. He supported progressive political reforms, women's suffrage, expansion of public utilities, abolition of child labor, Christian Socialism, and numerous other reform movements and causes. He is also considered the father of direct democracy (the initiative, referendum, and recall) in Los Angeles and California because of his activist role in securing the adoption of these measures. Since 1927 the Haynes Foundation has supported research projects and academic scholarships related to Haynes's interest in the study and improvement of American political and social institutions.

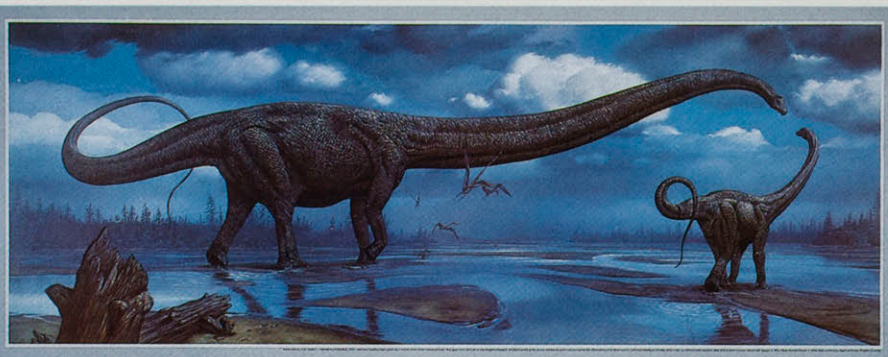
Tomorrow's Scientists Graduate from Natural Science Workshop. On May 9, 1987, the Natural History Museum awarded certificates of completion of its Natural Science Workshop to twenty Los Angeles area high school students. Since October 1986, these exceptional students voluntarily gave up watching their Saturday morning cartoons for peering through microscopes to study the antics of plankton. While their classmates strolled through the local Galleria or were hanging out at the beach, these students were sorting invertebrate research specimens dredged from the ocean depths off the Galapagos Archipelago or studying mammal skulls ranging from those of aardvarks to zebras.

The Natural Science Workshop offers a unique opportunity for students to enhance and expand their education in the sciences. This free program begins with a semester of lectures presenting an overview of scientific principles and disciplines. The students take behind-the-scene tours of the museum's collections, laboratories, and research facilities. In the spring, the students choose to study a particular discipline. This year's class focused its attentions on either mammalogy, coordinated by Dr. Sarah George, or marine biology, coordinated by Regina Wetzer. Here the students received in-depth instruction in their discipline and had the opportunity to learn how to use the museum's scientific equipment. They also went on field trips; for example, the mammalogy students went on an overnight camping trip to compare the mammals of the desert with the mammals of the low mountains, and the marine biology students took a trip to local tidal pools to study the diversity and numbers of invertebrates within the intertidal zones.

For further information on enrollment in the 1987–88 program, please contact Judy Chovan at 213/744-3535.

Regina Wetzer

Natural Science Workshop student Juliana Tutak studying intertidal invertebrates from the tidepools off the Palos Verdes Peninsula.



DINOSAURS PAST AND PRESENT

an exhibition organized by the
Natural History Museum of Los Angeles County

THE MIGHTY *MAMENCHISAURUS* ADORNS AWARD WINNING* MUSEUM POSTER

Local artist Mark Hallett lends a highly realistic and sensitive portrayal of a huge prehistoric creature known as *Mamenchisaurus.* Recently unearthed in the People's Republic of China, this animal boasted the longest neck—33 feet—of any known vertebrate.

A cast of the fossil skeleton of this dinosaur belongs to the Natural History Museum, and the painting is currently touring the country as part of the museum's Dinosaurs Past and Present exhibition. Now this distinctive rendering has been reproduced on an 18" by 36" poster and priced at $7.50. It is available at the Natural History Museum Bookstore or by mailing the handy mail order blank below.

*American Association of Museum Publications Competition Award of Merit

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